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BALLOON ABOVE CANADA SEARCHES FOR ANTIMATTER AND OTHER COSMIC PARTICLES

High above the Canadian plains, Japanese and U.S. scientists have harvested another crop of antimatter particles, in the latest flight of a balloon-borne experiment named BESS which has flown nearly every summer since 1993 searching for evidence of an antimatter domain within our Universe.

BESS (Balloon-borne Experiment with a Superconducting Spectrometer) lifted off from Lynn Lake in Manitoba, Canada, August 7 at 8:58 p.m. local time on a 22 hour flight. The 5,300-pound experiment flew beneath a 40-million-cubic-foot balloon, NASA's largest, at an average altitude of approximately 23 miles. BESS was retrieved last night near Fort McMurray, Alberta, and the team will now begin sorting through the new data.

Dr. Akira Yamamoto of the High Energy Accelerator Research Organization in Japan (known as KEK) and Dr. John Mitchell of NASA's Goddard Space Flight Center in Greenbelt, Maryland, co-lead this international experiment, which is jointly sponsored by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan and NASA.

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Antimatter particles are forms of matter with electrical charges exactly the opposite of their ordinary "sister" particles. Whereas a proton has a positive charge and an electron has a negative charge, an antiproton has a negative charge and an antielectron (or positron) has a positive charge. The simplest version of the Big Bang theory predicts there are equal amounts of matter and antimatter in the Universe, yet scientists have largely detected only ordinary matter.

BESS contains an instrument that detects a variety of cosmic rays, which are atomic particles moving through space at nearly the speed of light. Some of these particles are antiprotons created by collisions of ordinary matter deep in space. The strong magnetic field of the BESS superconducting magnet in conjunction with its high-resolution particle detectors enables a very sensitive search for antimatter in the Universe.

If BESS were to find a sophisticated form of antimatter, such as an anti-helium nucleus, it would provide evidence that antimatter galaxies exist. Anti-helium is virtually impossible to create by any known process, such as an ordinary particle collision, and would have to come from a source composed of antimatter.

"It is still a fundamental question why we do not observe antimatter balancing with matter in the Universe," said Yamamoto. "We have actually found no anti-helium in our data taken during the seven flights from 1993 to 2000, while we have detected seven million helium nuclei. That fact provides the most direct evidence that our Galaxy and those nearby are made solely of matter, not antimatter. Why does nature appear to have not taken the simple path of matter and antimatter balance?"

Theories have been proposed to explain the apparent dearth of antimatter in the Universe. Russian physicist Andrei Sakharov proposed three conditions in 1967 that, if met, would allow a predominance of matter over antimatter in the early Universe. In the laboratory setting, physicists have demonstrated that some of these conditions can be met, but it is not proven that all are met.

As in years past, BESS' August 2002 catch will likely yield antiproton cosmic rays among the millions of particles detected. Even though most of the antiprotons are created as "secondaries" in well-understood cosmic-ray collisions in deep space, there might be a chance to detect antiprotons of cosmic-origin such as primordial black holes that might be created in the very early Universe.

"It would be of extraordinary interest if BESS were to detect antiprotons in excess of those expected as secondary particles," said Mitchell. "There are hints in the current data, but, as always, more data is needed."

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Balloons offer an inexpensive platform to search for antimatter. After each yearly flight, the BESS team improves the instrument for the next flight, resulting in a steadily increasing number of particles collected. The next BESS flight is anticipated for Antarctica in December 2003 and January 2004, where scientists hope to fly the experiment for two weeks continuously, collecting a large amount of data.

The BESS collaboration includes researchers at NASA Goddard and the University of Maryland in the United States; and at the High Energy Accelerator Research Organization, Kobe University, the University of Tokyo, and the Institute of Space and Astronautical Science, all in Japan.

The balloon campaign in Canada is conduced by the National Scientific Balloon Facility, Palestine, Texas, through the NASA Scientific Balloon Project Office at Goddard's Wallops Flight Facility, Wallops Island, Virginia. In addition to the BESS flight, two flights will be conducted from Lynn Lake in August for the University of Delaware.

For an image of the BESS payload prior to launch, refer to:

http://www.gsfc.nasa.gov/topstory/20020809balloon.html

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